

The Study on Flow Velocity Measurement of Antarctic Krill Trawl Model Experiment in North Bay of South China Sea

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Abstract: From August 25 to 29, 2014, the project team carried out the experiment of Antarctic krill trawl in the Beihai Bay of the South China Sea. In order to understand the flow field of the network model in the course of the experiment, it is necessary to record the speed of the ship and to grasp the flow field of the ocean. Therefore, the ocean velocity is measured during the experiment. The flow rate in this experiment was measured using an acoustic Doppler flowmeter (Vectrino Plus, Nortek, Norway). In order to compensate for the flow rate error caused by ship drift, the drift condition of the ship was also measured by the positioning device (Snapdragon MSM8274AB, Qualcomm, USA) used in the flow rate measurement. The results show that the actual velocity of the target sea area is in the range of 0.06-0.49 m / s and the direction is 216.17-351.70. And compared with the previous research, the influencing factors were analyzed. This study proves that it is feasible to use point Doppler flowmeter for velocity study in trawl model experiment.

Key Words: Trawl Model Experiment, Flow Velocity, GPS

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From August 25 to 29, 2014, the project team carried out the experiment of Antarctic krill trawl in the Beihai Bay of the South China Sea, and studied the resistance of the net, the expansion of the screen and the height of the network port. In order to understand the flow field of the network model in the course of the experiment, it is necessary to record the speed of the ship and to grasp the flow field of the ocean. Therefore, the ocean velocity is measured during the experiment.

1 Materials and methods

1.1 Flow rate measurement

The flow rate in this experiment was measured using an acoustic Doppler flowmeter (Vectrino Plus, Nortek, Norway) with a system sound of 10 MHz and an accuracy of $\pm 0.5\%$ of the measured value, belonging to a high-precision three-dimensional instrument. It uses the principle of acoustic Doppler measurement to measure the flow rate with the Doppler shift of the acoustic wave in the flow field. The main components of the device 4-arm flat-panel sensor installed in the 40cm long rod-type fixed fixed probe probe, there are four focus beam, the probe

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size is small, greatly reducing their impact on the flow field. No moving parts, no friction and hysteresis, measurement of induction time fast, you can 200 Hz sampling rate to measure the flow field velocity. The measurement data is read by the software (Vectrino + 1.14, Nortek), which monitors and records the change in flow rate over time.

In the measurement, the probe of the flowmeter is fixed at 2 m below the water level of the ship side. The X axis is aligned with the direction of the bow, the Z axis is perpendicular and the Y axis is perpendicular to the X axis and the direction is perpendicular to the ship's side. Flow rate measurement data acquisition interface and data output as shown in Figure 1, a total of 20, from the data can be read in the sensor measurement data correlation coefficient were 98,97,97,96, in general screening correlation coefficient greater than 70 Data, this group of data quality is good. X, Y, Z in the direction of the flow rate were -0.147, -0.026, 0.011. Data analysis, flow rate size, direction calculation and other basic statistical analysis and steady-state, correlation, spectrum analysis and other analysis in the flow rate analysis software (ExploreV Pro 1.58, Nortek AS, Norway).

According to the ocean hydrological observation GB, the flow rate measurement time is 3 min. The flow velocity in the experiment is based on the velocity in the three directions. According to the distribution of the flow direction in the whole measurement process, the direction of the flow velocity is the most instantaneous velocity direction, as shown in Fig. 2, when the flow velocity direction is -151 °. The direction of the direction of the bow is 0, the vertical ship is 90 °outward, the stern direction is 180 °, and the vertical ship's side is -90 °.

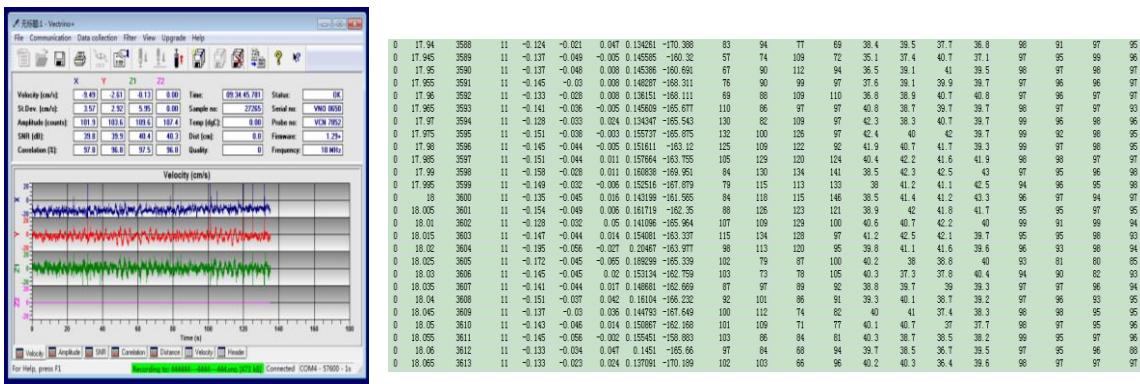


Figure 1 flow rate measurement data acquisition interface and data output situation

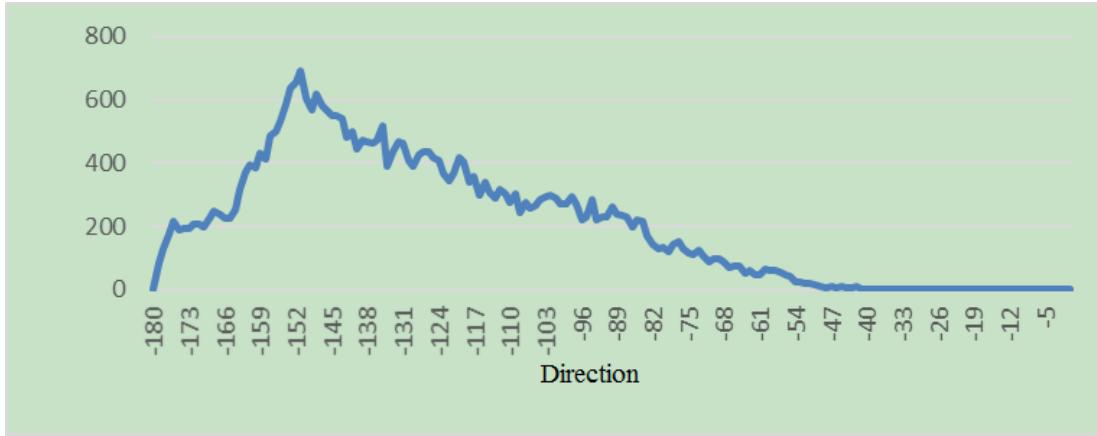


Fig.2 Flow direction distribution in the measurement

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1.2 Experimental ship motion measurement

According to the provisions of the National Standard Ocean Survey (Part 2: Ocean Hydrological Observations (GB / T 12763.2-2007) (hereinafter referred to as the national standard for marine hydrology observation), the ship needs to be anchored when measuring the ocean flow velocity, but this test Conditions can not be related to the restrictions. In order to compensate for the flow rate error caused by ship drift, the drift condition of the ship was also measured by the positioning device (Snapdragon MSM8274AB, Qualcomm, USA) used in the flow rate measurement. The output of the positioning data is the NMEA0183 standard format developed by the National Ocean Electronics Association. It is a string of ASCII codes. Each set of data has two kinds of statements. GPGGA, GPRMC, for example, a set of data is as follows:

\$ GPGGA, 15334, 1954.2826, N 10930.4979, E, 1,27,3, -10 M, 0000 * 3A

\$ GPRMC, 15334, A, 1954.2826 N, 10930.4979, E, 0.6, 292.7, 290814, * 02

It can be seen that the location of the positioning equipment is single point positioning, the number of satellites is 27, the horizontal accuracy factor is 3, the experimental ship drift movement rate is 0.6 kn, the direction of motion is 292.7, the relevant data in the ocean data view application software ODV 4.5.6, AWI, German), the trajectory of the experimental ship drift is shown in Fig. 2. Generally speaking, the drift of the experimental ship can be considered as a uniform motion, and the whole of the drift trajectory can be obtained Drift displacement of the ship during flow measurement. Combined with the time of the whole process to obtain the speed of the ship drift.

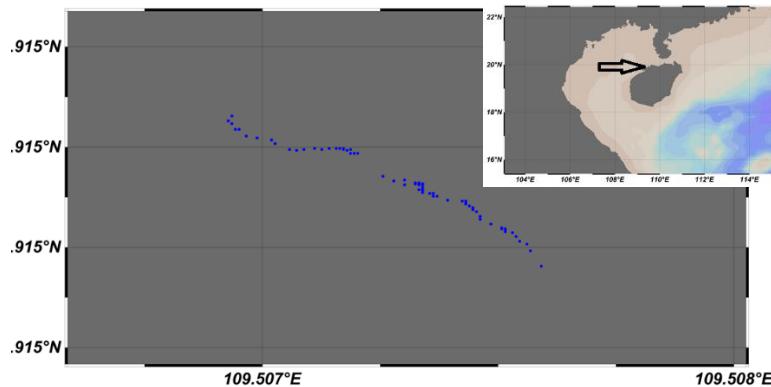


Fig.2 Trajectory of drift motion of experimental ship

1.3 actual ocean velocity calculation

The actual velocity of the ship is superimposed on the velocity of the ship and the actual ocean velocity is obtained. According to the ocean hydrological observation of the national standard, continuous observation of the current at least once per hour observation. In order to maintain the consistency of the experimental conditions in the whole group of experiments, the flow rate measurement is carried out before the start of each experiment, and the actual ocean velocity is obtained as the ocean velocity in the experiment.

2 Results

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The flow rate measurement results obtained according to the above method are shown in Table 1.

Table 1 Flow rate measurement results table

No.	Time	Flow	Direction	Boat speed	Boat speed Direction	Actual flow	Actual flow Direction
1	08-28 10: 38	0.293	-151	0.37	295.3	0.18	243.98
2	08-29 09: 49	0.235	-111	0.42	305.8	0.40	272.64
3	08-29 15: 46	0.296	160	0.57*	316.3*	0.30	330.81
4	08-30 09: 31	0.117	-155	0.135	292.2	0.06	351.70
5	08-30 13: 45	0.192	-77	0.41	238.6	0.49	216.17

Note 1: the flow rate in the table refers to the measured flow rate, the speed refers to the process of measuring the speed of the ship drift, the actual flow rate refers to the actual ocean flow rate.

Note 2: The direction of the flow direction is 0, the vertical ship's side is 90 ° outward, the stern direction is 180 °, and the vertical ship's side is -90 °.

Note 3: The flow rate unit in the table is m / s and the direction unit is °.

Note 4: The third group of experimental ship speed size and direction are instantaneous value, because this group of GPS data quality is poor.

3 Conclusion

3.1 Related measurement results reference

For the experimental waters and roughly the same time, 2006-2007 Xiamen University, China Ocean University, South China Sea Fisheries Research Institute, South China Sea Institute of Ocean through 908 special (908-01-ST09) had Qiongzhou Strait west of the acoustic Doppler (ADCP, Acoustic Doppler Current Profilers) measured the flow rate^[1], its position as shown in Figure 4 M3, and the experimental area is similar.

The site's velocity profile began on July 23, 2006, and finally on August 24 of August. The observed results show that the flow field of the site is stronger in August (Figure 3). During the period from 3 August to 21 August, the M3 was basically eastward, with the exception of August 5, 10, 11 and 14. In the August 21 to 24, M3 and turn to the west to the flow, which 21 and 24, the entire vertical water are west, but 22 and 23 of the West flow mainly in the upper 7m of water.

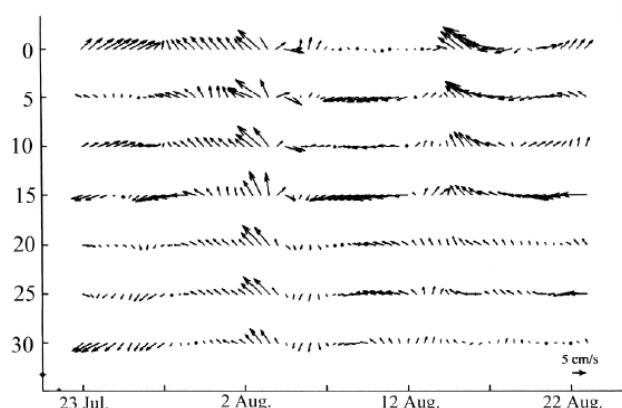


Figure 3 July 2006 - August 24 observed at the M3 station flow field [1]. Where y axis represents water depth, Arrows up and right respectively represent velocity towards north and east.

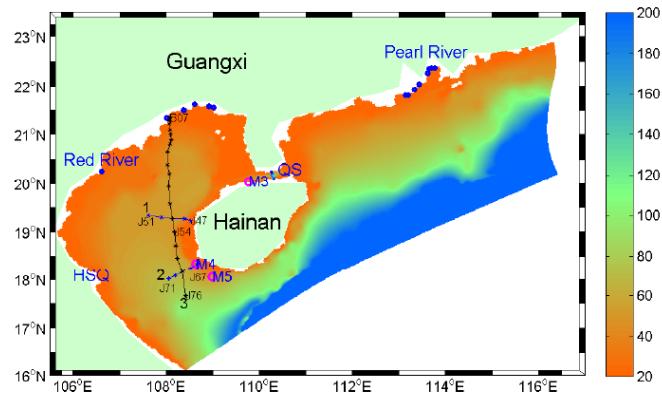


Figure 4 M3 station location diagram

4.2 A brief analysis of the influencing factors

In general, there are three factors, such as tidal and Qiongzhou Strait, which are affected by the velocity of the experimental sea. According to Li Shuhua et al. [2], the numerical simulation of the North Bay tidal wave system is carried out. The experimental waters may be normal tide Tidal opposite, for the irregular day trend; Qiongzhou Strait on the northern Gulf of water supply flux and vorticity of the northern part of the northern part of the circulation also plays a key role; the other in the northeastern part of the northern part of the circulation and the monsoon higher correlation, There are significant seasonal changes in the characteristics of the North Bay is mainly controlled by the East Asian monsoon system, summer for the southwest wind, and winter for the northeast wind.

Reference:

- [1] Zhang Guorong, Pan Weiran,etc, Characteristics of winter and spring water transport in the east and north of North Gulf in China[M], North Bay Ocean Science Research Proceedings (Part 2), Ocean Press,2009,64-76
- [2] Li Shuhua, Numerical Calculation of Tidal Current in North Gulf [J], Marine Science Bulletin,1985,4(6):6-9